Hindawi
Dermatologic Therapy
Volume 2023, Article ID 8827644, 16 pages
https://doi.org/10.1155/2023/8827644

Review Article

Efficacy and Safety of Platelet-Rich Plasma Therapy in Alopecia Areata Patients: A Systematic Review

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Received 3 January 2023; Revised 22 July 2023; Accepted 16 August 2023; Published 26 August 2023

Academic Editor: Qiuning Sun

Objectives. To determine the efficacy of platelet-rich plasma in treating alopecia areata. *Methods*. A systematic search was carried out in PubMed, Embase, and the Cochrane Library databases to identify any article evaluating the efficacy of platelet-rich plasma for the treatment of alopecia areata and comparing platelet-rich plasma with other treatment modalities. *Results*. Nine studies were included based on our inclusion criteria with a total of 616 patients. Various evaluations of alopecia areata treatment efficacy with platelet-rich plasma, including the comparison between platelet-rich plasma and triamcinolone acetonide, minoxidil, placebo, and other methods, such as fractional carbon dioxide laser and microneedling, were conducted in the included studies. The main results revealed that platelet-rich plasma and triamcinolone acetonide are both effective in the treatment of alopecia areata. However, the treatment response was in favor of platelet-rich plasma. Also, minoxidil showed positive effects on the treatment of alopecia areata alongside platelet-rich plasma. Platelet-rich plasma also has significantly better effects on alopecia areata compared to placebo. Most of the side effects of treatment of alopecia areata with platelet-rich plasma were minor, including burning sensation, pain during injection, erythema, edema, ecchymosis, crust formation, and headache. *Conclusion*. Based on the evidence reviewed, it is suggested that platelet-rich plasma is a safe and effective treatment option for alopecia areata. Furthermore, platelet-rich plasma has the advantage of being a steroid-sparing therapy, reducing the reliance on corticosteroids. The use of platelet-rich plasma is associated with fewer complications compared to other treatment modalities.

1. Introduction

Alopecia areata (AA) or area celci is a common and also nonscarring alopecia. AA is characterized by patchy areas of hair loss, mostly on the scalp, with no signs of inflammation [1]. AA affects 1.7% of the population, both men and women [2]. In 2% of cases, AA can spread to the body or the entire scalp, also known as alopecia universalis and alopecia totalis, respectively [3]. The underlying cause of AA is mainly related to inflammatory factors or genetic autoimmunity [4, 5]. However, the exact trigger factors of AA are under investigation and are still unknown. Key events for the development of AA are triggered by T cell-mediated immune attacks, which involve hair bulbs, after the loss of the immune privilege of the hair bulbs. The loss of the immune privilege of hair follicles leads to the involvement of alpha-melanocyte-stimulating hormone (α-MSH), transforming growth factor-beta (TGF-β), and also interleukins. Moreover, it results in decreased levels of major histocompatibility complex (MHC) [6]. Different treatment lines for AA

are presented in Figure 1 in detail. Intralesional corticosteroids for mild AA and topical immunotherapy for extensive cases are considered first-line treatments for AA [7]. Moreover, immunosuppressive agents, especially Janus kinase (JAK) inhibitors such as tofacitinib and baricitinib, are introduced as potent treatment options for AA. Platelet-rich plasma (PRP) is an autologous preparation of platelets in a small and concentrated volume of plasma. PRP promotes hair growth by accelerating the circulation to hair follicles due to cellular molecules and the presence of growth factors [8–10]. PRP is an effective treatment for hair loss, but it has some limitations, including pain, poor coverage of the involved area, and the absence of a standardized PRP concentration. The mechanism of PRP for the treatment of AA is still unclear, but it has been reported that PRP can suppress cytokines release through its anti-inflammatory effects [11]. The preparation of PRP should be done on the day of the treatment, with between 10 ml and 60 ml of whole blood extracted into a sterile tube in addition to anticoagulant agents. Then, the different cell types of the blood will be separated using a centrifuge device to obtain PRP. There is scarcely any available data regarding the efficacy of using PRP for the treatment of AA. Therefore, we aimed at conducting a systematic literature review to achieve a comprehensive conclusion regarding this goal.

2. Methods

This systematic review was conducted following the guidelines of the Cochrane Handbook for Systematic Reviews and Meta-Analyses and adhering to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement. The objective of this study was to evaluate the efficacy of PRP in the treatment of alopecia AA.

2.1. Search Strategy. A comprehensive search was performed in three electronic databases: PubMed, Embase, and the Cochrane Library, to identify relevant articles. The search strategy encompassed the terms "PRP," "platelet-rich plasma," "platelet-rich plasma," "platelets rich plasma," "alopecia areata," and combinations thereof (Table 1). No restrictions were applied to the publication date, and articles published from the inception of the databases to October 29, 2022, were included. Reviews, meta-analyses, case reports, and non-English studies were excluded.

2.2. Eligibility Criteria. The major inclusion criterion was the presence of AA in the study participants. Exclusion criteria encompassed severe AA cases with any hair loss, that is, ≥50%, children, patients with comorbidities such as diabetes mellitus, hypertension, malignancies, viral hepatitis, and hypothyroidism, pregnant or lactating women, women planning for pregnancy, immunocompromised patients, individuals with scalp inflammation or any scalp disease, patients with alcohol or drug abuse, those consuming anticoagulant agents, individuals with low hemoglobin or platelet levels, prior adverse reactions to intralesional steroids, history of systemic or intralesional steroid therapy, and recent history of AA treatment.

2.3. Study Selection and Data Extraction. Two independent reviewers conducted the initial screening of titles and abstracts based on predetermined inclusion and exclusion criteria. Disagreements were resolved by a third reviewer. Full-text articles were then retrieved and assessed for confirmation of inclusion criteria and data extraction.

Data extraction was performed by two reviewers using a standardized Excel-based sheet. The extracted data included the names of the first authors, year of publication, number of cases, baseline characteristics of patients, inclusion and exclusion criteria, treatment and follow-up methods, outcomes, and complications.

2.4. Quality Assessment. The quality assessment of the included studies was carried out independently by the reviewers using the Cochrane Collaboration tool. Any discrepancies were resolved through consensus or consultation with a third reviewer.

3. Results

3.1. Overview of the Studies. This systematic review was based on a comprehensive search that yielded a total of 150 articles. The articles were in PubMed, Embase, and the Cochrane LibraryIinternational Bibliometric databases. After removing duplicates, 56 articles remained for screening. Initially, 23 full-text publications remained, and nine articles were included in our study based on our inclusion criteria (Figure 2). Fourteen studies were excluded from our full-text screening due to the unavailability of the full texts and improper study design, including review articles and case reports. The baseline characteristics of the included studies are presented in Table 2. The included studies were conducted in three different countries, including Egypt, with the most articles ($n = 4$) [12–15], Italy ($n = 3$) [16–18], and India ($n = 2$) [19, 20]. The studies were published between 2013 and 2021, but the majority of them have been published in recent years (2019–2021). A total of 616 patients were evaluated in the included studies. The results of the quality assessment of the included studies are presented in Figure 3.

3.2. Different Evaluations of the PRP Therapy. In the included studies, there have been different assessments of the treatment efficacy of PRP, including comparisons between PRP and triamcinolone acetonide, minoxidil, placebo, and other methods.

3.3. PRP versus Triamcinolone Acetonide ($n = 5$). Triamcinolone acetonide is a corticosteroid that is used for a variety of conditions, including dermatological diseases and alopecia conditions. Five studies compared the treatment effects of PRP and triamcinolone on AA patients. In the study by Trink et al., there was a significant hair regrowth in lesions of AA in the PRP group and also in the triamcinolone group than in the placebo group when compared to the other side of the scalp, which was untreated [18]. There was also a significantly better treatment response in the PRP group compared to the

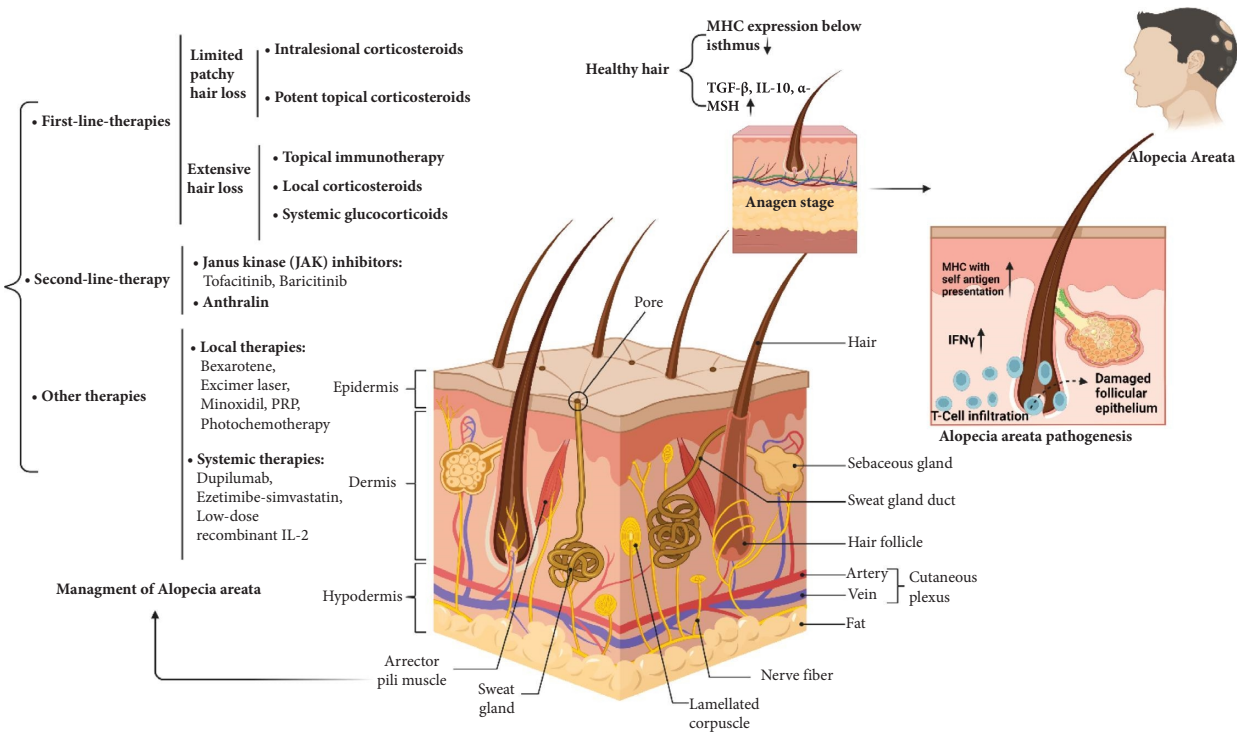

Figure 1: Different treatment lines for alopecia areata.

Table 1: Detailed search strategy used for each database.

Database	Search string
PubMed	(("platelet-rich plasma" OR "PRP" OR "platelets rich plasma" OR "platelet-rich plasma") AND ("alopecia areata" OR "alopecia"))
Embase	("platelet-rich plasma" OR "PRP" OR "platelets rich plasma" OR "platelet-rich plasma") AND ("alopecia areata" OR "alopecia")
Cochrane libraries	(title: ("platelet-rich plasma" OR "PRP" OR "platelets rich plasma" OR "platelet-rich plasma") AND title:("alopecia areata" OR "alopecia"))

triamcinolone group in terms of hair regrowth, including fully pigmented hair. In two studies, the difference between the effects of PRP and triamcinolone was insignificant [12, 19]. However, it was reported that the treatment response was better in the PRP group [19], with significantly more regrowth of pigmented hair and a decrease in dystrophic hair in both groups compared to baseline [12]. In the study by Hegde et al. [20], the maximum hair growth was observed in the triamcinolone group compared to the PRP group. However, both groups had significant hair regrowth compared to the baseline period. Fawzy et al. [14] reported that there was a statistically significant decrease in the Alopecia Areata Symptom Impact Scale (AASIS) in the PRP group compared to the triamcinolone group. In addition, both groups had significantly lower severity of alopecia tool (SALT) scores compared to baseline.

3.4. PRP versus Placebo (n = 2). Two studies compared the AA treatment response between PRP and a PRP-like product with a placebo [16, 17]. In both studies, there was a significantly better response in the experimental groups compared with the placebo groups in terms of hair regrowth and complete regression.

3.5. PRP versus Minoxidil (n = 1). Minoxidil is a piperidinopyrimidine derivative that was first used for the treatment of hypertension and, later on, for baldness [21, 22]. There was one study that compared PRP and minoxidil. [13]. Both PRP and minoxidil had better effects on patchy AA than on AA universalis. In addition, there was no response from AA totalis to the treatment with PRP or minoxidil. It was reported that PRP led to significant hair regrowth in fully pigmented hair with an earlier and better response compared with minoxidil. Significant decreases in short vellus hairs, dystrophic hair, and also yellow dots were noted in the same study. Also, there was only a 30% significant improvement in the patchy AA in the placebo group, with an increase in short vellus hair and a decrease in yellow dots.

3.6. Additional Methods for PRP (n = 1). Ragab and his team assessed the combination of topical PRP treatment in addition to other methods, including fractional carbon dioxide laser and microneedling [15]. The results showed that there were better responses in all groups regarding hair regrowth compared to the baseline period, but the difference between the groups was not statistically significant.

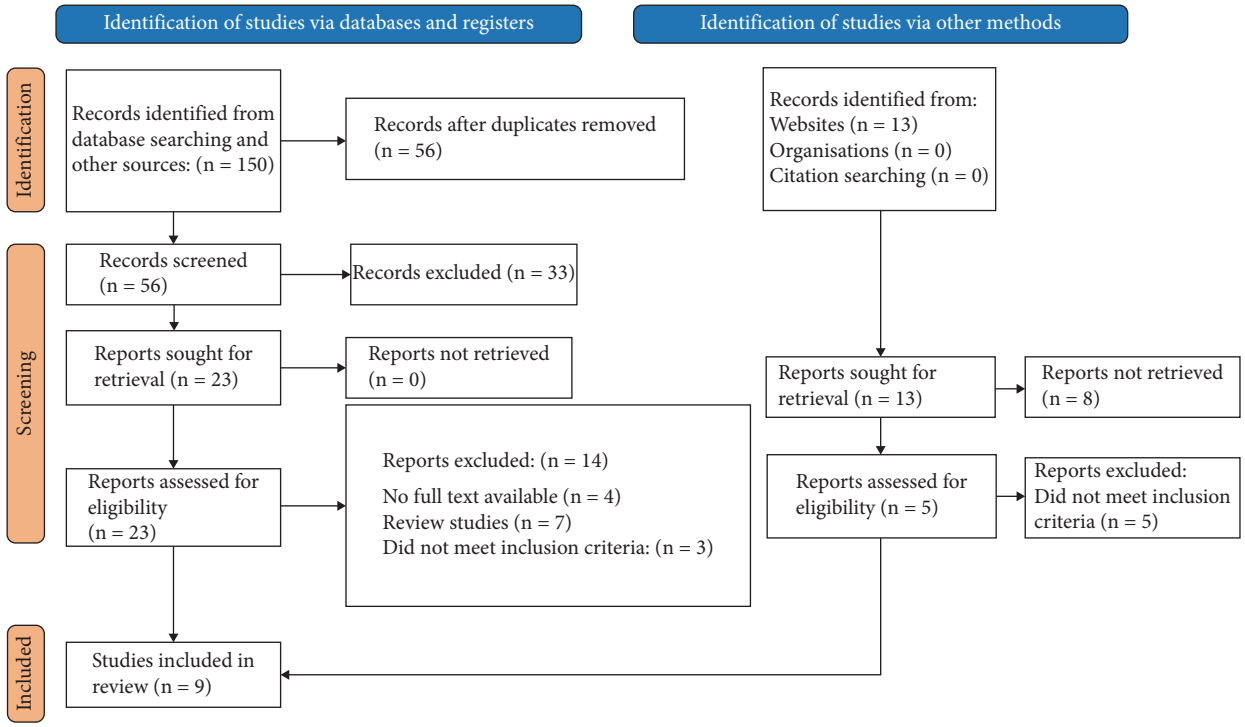

Figure 2: PRISMA flowchart of the literature search and selection of the articles.

3.7. Side Effects. Some patients in the included studies experienced different side effects of the utilized treatment agents, including burning sensation, pain during injection, erythema, edema, ecchymosis, crust formation, and headache. However, the majority of the mentioned side effects were self-limited with no further persistent complications.

4. Discussion

AA is a chronic, immune-mediated disorder that targets hair follicles in the anagen stage and causes nonscarring hair loss [23]. AA is described by patchy areas of complete hair loss on the scalp or other body parts [24]. Nail involvement is estimated to occur in 10 to 20 percent of patients with AA and may precede, follow, or coexist with active hair loss [25]. AA is approximately present in 1.7% of people, and there is no difference in the incidence of this disorder between males and females [2, 26]. Some factors like the onset of AA in childhood, severe types of the disease such as alopecia totalis and alopecia universalis, a duration of more than one year, band-like involvement of the peripheral temporal and occipital scalp (ophiasis pattern), nail involvement, atopy, and a family history of AA are risk factors for a poor prognosis or a high prospect of relapse [27–30]. The diagnosis of AA is based on the history and physical examination [31]. Yellow dots, short vellus hairs, black dots, tapering hairs, and broken hairs are clinical findings that can be seen in dermoscopic investigations in AA patients [32, 33]. A skin biopsy might be helpful when a precise diagnosis of AA is not possible through the history or clinical examination of the patients [34].

Topical corticosteroids are widely used as a first-line treatment for alopecia areata. These anti-inflammatory medications help suppress the immune response attacking the hair follicles, promoting hair regrowth. They are available in various strengths and formulations, such as creams, lotions, and foams. The effectiveness of topical corticosteroids varies depending on the extent of hair loss and the duration of the condition. In cases where topical corticosteroids prove ineffective, intralesional corticosteroid injections are often recommended. This treatment involves injecting corticosteroids directly into the affected area, delivering a potent dose to the hair follicles. The injections are typically administered every four-to-six weeks, and multiple sessions may be required. Intralesional corticosteroid injections have shown promising results, especially for smaller patches of hair loss [35].

Topical immunotherapy aims to modulate the immune response by inducing an allergic reaction on the scalp. Agents such as diphencyprone (DPCP) or squaric acid dibutylester (SADBE) are applied to the scalp, stimulating an allergic response that redirects the immune system away from attacking hair follicles. This treatment is reserved for patients with extensive alopecia areata and has shown favorable outcomes in promoting hair regrowth [36].

JAK inhibitors have emerged as a breakthrough therapeutic option for alopecia areata. These oral medications work by inhibiting the signaling pathways involved in the immune attack on hair follicles. Recent clinical trials have shown remarkable results, with some patients experiencing complete hair regrowth. However, long-term safety and efficacy data are still being evaluated, and JAK inhibitors

Table 2: Characteristics of included studies.

Studies	Countries	Number of cases	Mean age (SD)	Male/female	Inclusion criteria	Follow-up	Groups	Main findings
Trink et al. [18]	Italy	45	PRP: 28.8, triamcinolone: 27.2, and placebo: 28.1	20/25	(i) AA patients who are generally in good health (ii) Chronic and recurring illness that has persisted for a minimum of two years (iii) Presence of 4–6 symmetrical patches of hair loss	1 year	PRP group, triamcinolone acetonide (TrA) group, and placebo group	(i) Patients in the PRP and TrA groups showed significantly increased hair regrowth compared to the placebo group (ii) The PRP group had a higher rate of complete remission (60%) at T3 (a specific time point) compared to the TrA group (26.6%) (iii) In the TrA group, 38% experienced a relapse of the disease at T2 (another specific time point), while no patients in the PRP group had a relapse (iv) Both the PRP and TrA groups had increased hair regrowth compared to the untreated side of the scalp (v) In the TrA group, 71% experienced a relapse at T3, while only 31% in the PRP group had a relapse (vi) 96% of the PRP group experienced regrowth of fully pigmented hair from the beginning of hair growth, while only 25% in the TrA group had the same outcome (vii) Both groups also reported decreased itching and burning

Table 2: Continued.

Studies	Countries	Number of cases	Mean age (SD)	Male/female	Inclusion criteria	Follow-up	Groups	Main findings
El Taieb et al. [13]	Egypt	90	PRP: 19.76 (9.09), minoxidil: 22.63 (9.97), and placebo: 20.87 (8.09)	PRP: 15/15, minoxidil: 14/16, and placebo: 10/20	AA patients aged between 10–40 years, with no therapy for at least 3 months before study	3 months	PRP group, minoxidil 5% group, and panthenol group (placebo)	(i) PRP was more successful in treating patchy alopecia than alopecia universalis but was found to be ineffective in treating alopecia totalis (ii) PRP treatment resulted in a significant decrease in short vellus hair, yellow dots, and dystrophic hair, distinguishing it from the effects of minoxidil and the placebo (iii) PRP treatment showed an earlier and more favorable response in terms of hair regrowth and reduction in short vellus hair and yellow dots compared to other treatments
Albalat and Ebrahim [12]	Egypt	80	PRP: 30.8 (7.5) and steroid: 36.3 (11.3)	PRP: 34/6 and steroid: 34/6	Healthy persons of both sexes, aged between 17 and 52 years with patchy alopecia	6 months	PRP group, intralesional corticosteroid (ILC) group	(i) By the 12th week, the PRP group showed more improvement compared to the steroid group, but there was no significant difference between the two. The recurrence rate was 5% in the PRP group and 25% in the steroid group
Rinaldi et al. [16]	Italy	60	54.32 (8.17)	37/23	AA patients aged between 18 and 60 years	3 months	TR-M-PRP group and placebo group	(i) The TR-M-PRP group showed a complete regression rate of 53.33%, indicating a significant reduction in the severity of alopecia, whereas the placebo group had a complete regression rate of only 3.33%

Table 2: Continued.

Studies	Countries	Number of cases	Mean age (SD)	Male/female	Inclusion criteria	Follow-up	Groups	Main findings
Hegde et al. [20]	India	50	N/A	N/A	AA patients	3 months	PRP group and steroid group/placebo	(i) The steroid group exhibited the highest absolute growth and percentage regrowth, followed by the PRP group and the placebo group. There were statistically significant differences in both parameters between the groups (ii) Dermoscopic grading decreased in all three groups, but the decrease was not statistically significant (iii) By the end of 3 months, 44% of the PRP patients and 40% of the steroid patients had nearly complete regrowth of hair

Table 2: Continued.

Studies	Countries	Number of cases	Mean age (SD)	Male/female	Inclusion criteria	Follow-up	Groups	Main findings
Fawzy et al. [14]	Egypt	31	PRP: 31.41 (10.64) and triamcinolone: 34.21 (12.27)	PRP: 13/4 and triamcinolone: 10/4	AA patients aged 18 years or above	3 months	PRP and triamcinolone group	(i) Both groups, PRP and triamcinolone, showed a significant decrease in SALT scores (severity of alopecia tool) compared to their baseline levels (ii) The PRP group demonstrated a significant decrease in AASIS scores (alopecia areata symptom impact scale), while the triamcinolone group did not show a significant decrease (iii) In the triamcinolone group, there was a statistically significant positive correlation between baseline SALT scores and baseline AASIS scores. However, this correlation was not observed in the PRP group (iv) There was also a statistically significant correlation between baseline and final AASIS scores and baseline and final SALT scores in the PRP group (v) Both groups showed statistically significant improvement in trichoscopic findings. There was a statistically significant link between the dystrophic alterations score and the percentage of improvements in SALT and AASIS scores

Table 2: Continued.

Studies	Countries	Number of cases	Mean age (SD)	Male/female	Inclusion criteria	Follow-up	Groups	Main findings
Ragab et al. [15]	Egypt	60	PRP: 30.2 (11.49), fractional carbon dioxide laser (FCL): 34.2 (14.55), and microneedling MND: 29 (7.64)	PRP: 18/2, FCL: 14/6, and MND: 16/4	AA patients	6 months	PRP group, FCL group, and microneedling group	(i) In the PRP, FCL, and MND groups, 80%, 80%, and 70% of patients, respectively, experienced improvement in their condition (ii) There was no significant difference observed in the degree of improvement between the three groups (iii) All patients who showed improvement in their condition maintained these improvements without any recurrence or regression during the follow-up period (iv) There was no significant relationship found between the degree of improvement at the end of the treatment sessions and factors such as patient age, disease duration, patient sex, or the distribution of AA

Table 2: Continued.

Studies	Countries	Number of cases	Mean age (SD)	Male/female	Inclusion criteria	Follow-up	Groups	Main findings
Rinaldi et al. [17]	Italy	160	PRP: 51.84 (9.54) and placebo: 53.12 (6.18)	PRP: 44/36 and placebo: 37/43	Patients between the ages of 18 and 60 who have had AA for at least three years and whose AA has a SALT score between S2 and S5	3 months	TR-PRP group and placebo group	(i) After two months of treatment, the PRP group showed a significant improvement from the baseline SALT score (ii) In contrast, there was no significant change observed from the baseline to T1 and T2 in the placebo group (iii) Only 5% of the placebo group experienced complete regression of their condition (iv) In the PRP group, 47.5% of patients achieved complete regression, indicating a significant reduction in the severity of their condition (v) In addition, 13.75% of the PRP group achieved partial regression, while 6.25% did not respond to the treatment at all

Table 2: Continued.

Studies	Countries	Number of cases	Mean age (SD)	Male/female	Inclusion criteria	Follow-up	Groups	Main findings
Thyvalappil et al. [19]	India	40	N/A	PRP: 55%/45% and triamcinolone: 90%/10%	(i) The study enrolled patients who had not received any treatment for their AA in the three months prior to the study (ii) The participants in the study were required to be older than 18 years of age	12 weeks	PRP group and triamcinolone group	(i) There was no statistically significant difference in SALT scores between the two groups at other time points (ii) The treatment response was better in the PRP group compared to the triamcinolone group (iii) The hair regrowth scale did not show a significant difference between the two groups (iv) In the PRP group, 12.5% of patients had an excellent response, while none of the patients in the triamcinolone group had an excellent response (v) In terms of a good response, 31.3% of the PRP group and 18.8% of the triamcinolone group showed improvement (vi) On the other hand, a poor response was observed in 18.8% of the PRP group and 43.8% of the triamcinolone group

AA, alopecia areata; PRP, platelet-rich plasma; TrA, triamcinolone acetonide; AASIS, alopecia areata symptom impact scale; SALT, severity of alopecia tool; FCL, fractional carbon dioxide laser; MND, microneedling.

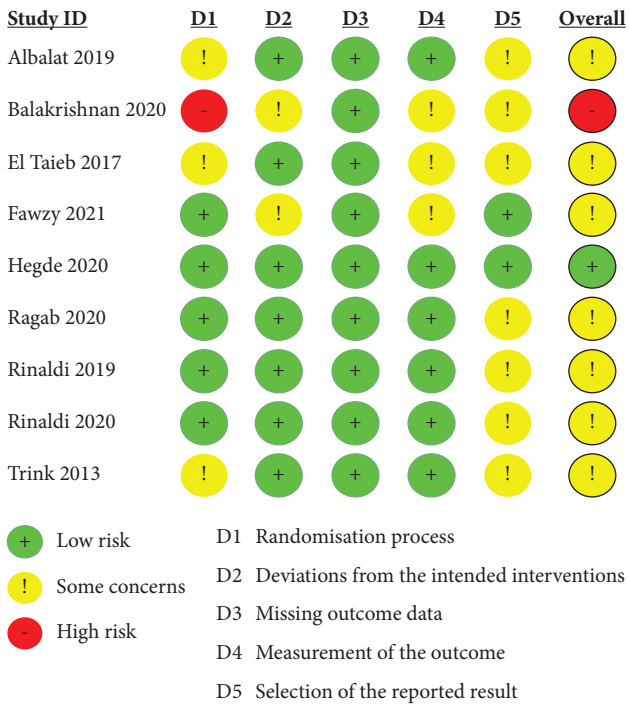

Figure 3: Results of the quality assessment of the included studies.

may have potential side effects that require close monitoring [35, 37].

In addition to the aforementioned treatments, other modalities are being explored for their potential in managing alopecia areata. These include minoxidil (a topical hair growth promoter), anthralin (a topical medication that alters immune function), and photodynamic therapy (combining light and photosensitizing agents to target immune cells with an excimer 308 nm laser). These alternative options may be used in combination with established treatments or when other approaches have proven ineffective [35, 38].

Recently, studies have reported that patients with AA may benefit from PRP therapy. PRP is an autologous concentration of platelets in a small volume of plasma-accelerating circulation, which can be beneficial to hair follicles [8, 9]. PRP contains growth factors and has anti-inflammatory properties [18, 39]. It has been previously shown that PRP has great therapeutic effects in the treatment of lichen sclerosis, maybe due to a reduction of inflammation, which can decrease the activity of the disease [40]. Also, PRP has adhesion molecules, which promote cell proliferation and differentiation [8, 9]. In this systematic literature review, we assessed the efficacy and safety of PRP in treating AA. As stated in the results section, we included 9 studies with a total of 616 patients evaluated. PRP has a multifaceted mechanism of action that contributes to general hair growth and its potential effectiveness in addressing the autoimmune mechanism underlying AA [10]. These effects are summarized in Table 3. It is important to note that the exact mechanisms of PRP's action in hair growth and in addressing the autoimmune component of AA are still being researched. The multifaceted nature of PRP's composition and its interactions with various biological processes make it a promising therapeutic option for both general hair growth and the autoimmune mechanism underlying AA.

In one of the included studies, which was conducted by Trink et al. [18], 45 patients were randomized to one of the three groups, including PRP, triamcinolone acetonide, and the placebo group. Patients were evaluated by Ki-67. Levels of Ki-67, a marker for cellular proliferation, were assessed from 20 hairs that were removed from the active margins of patches at each time point. PRP had significantly increased hair growth and decreased hair dystrophy and burning or itching sensations when compared with those treated with triamcinolone acetonide or placebo. Also, Ki-67 levels were significantly higher in the PRP experimental group.

In a study which was performed by Hegde et al. [20], 50 patients with AA were joined and divided into two treatment groups, including the PRP group and the steroid group. This article propounded that PRP can be a treatment option for patients with poor response and those not tolerating steroids. Also, PRP would be effective in patients with steroid consumption side effects. Moreover, in the study by Fawzy et al. [14], 31 patients with patchy AA were recruited and randomly divided into two groups, including the PRP group and the intralesional triamcinolone acetonide group. The results demonstrated that both intralesional triamcinolone acetonide and PRP were effective in patchy AA management.

In the study by Khademi et al. [48], the trial was on AA totalis, which is a severe type of AA. Ten patients with AA totalis were recruited, and the results revealed that PRP did not have a significant effect on hair growth. However, it should be noted that PRP treatment is guided towards patchy alopecia to enhance the hair regrowth mainly without any effect on the immunological cause of alopecia. In another study which was conducted by Ragab et al. [15], 60 patients with AA were joined and divided randomly into three groups, including PRP, fractional carbon dioxide laser, and microneedling groups. PRP was propounded as a safe and effective treatment, although intralesional PRP injection was related to significantly higher pain scores. Fabio et al. [16] planned a study on 60 patients with AA and divided the patients into two groups (TR-M-PRP plus group and placebo group). TR-M-PRP plus is a cosmetic product that is a biomimetic peptide for hair growth and is similar to PRP composition. In that study, the treatment with TR-M-PRP showed a significant improvement in SALT score three months after the initial treatment compared to baseline.

In a study which was performed by El Taieb et al. [13], 90 patients were joined and divided randomly into three groups (minoxidil, PRP, and topical panthenol cream). The group treated with PRP had an earlier response in the form of hair regrowth, a reduction in short vellus, and dystrophic hair. In the trial by Rinaldi et al. [17], 160 patients with AA were recruited to this study and divided into two groups, including a group treated with TR-PRP, which is a PRP-mimicking product, and a placebo group. A significant change from baseline was seen in the experimental group, and further improvement was seen during the study. Thyvalappil et al. [19] enrolled 40 patients with AA in their trial

Table 3: Mechanisms proposed for platelet-rich plasma (PRP) in the treatment of alopecia areata (AA).

General hair growth	Growth factors	PRP contains various growth factors, including platelet-derived growth factor (PDGF), transforming growth factor-beta (TGF-β), vascular endothelial growth factor (VEGF), and insulin-like growth factor (IGF). These growth factors play a crucial role in promoting hair follicle growth, proliferation, and differentiation [41, 42].
	Angiogenesis stimulation	PRP stimulates angiogenesis, the formation of new blood vessels. Improved blood supply to the hair follicles enhances nutrient and oxygen delivery, providing an optimal environment for hair growth and follicular regeneration [41].
	Stem cell activation	PRP contains bioactive substances that help activate and recruit dormant hair follicle stem cells. These stem cells have the potential to differentiate into hair follicle cells, promoting hair growth and regeneration [43].
	Extracellular matrix remodeling	PRP modulates the extracellular matrix, which provides structural support to the hair follicles. This remodeling process helps improve the hair follicle's anchoring ability, leading to stronger and healthier hair growth [44].
Autoimmune AA	Immunomodulation	PRP exhibits immunomodulatory properties by regulating the immune response and suppressing inflammatory processes. This modulation helps to reduce the autoimmune attack on hair follicles in AA [45].
	Anti-inflammatory effects	The growth factors and cytokines present in PRP possess anti-inflammatory properties. By mitigating the inflammatory response, PRP helps to alleviate the destructive impact of inflammation on hair follicles in AA [46].
	Wound healing and Tissue repair	PRP's regenerative properties aid in wound healing and tissue repair. This can be beneficial in repairing the damaged hair follicles and promoting a favorable environment for hair regrowth [47].

and divided the participants into two groups (PRP and triamcinolone). As a conclusion of this study, PRP was suggested as a safe, effective, steroid-sparing, and suitable alternative in AA management. Pain during injection, which was the only side effect, was also noticed in this study. In the study by Albalat and Ebrahim [12], 80 patients with AA were allocated to two groups (PRP and intralesional corticosteroids). The results demonstrated more improvement in patients who were treated by PRP, but regrowth of pigmented hair and a decrease in dystrophic hair were seen in dermoscopic evaluation in both groups. At the end of this study, PRP was suggested as a safe and promising therapeutic choice in AA management.

This systematic literature review has certain limitations that warrant further consideration. First, the heterogeneity in result reporting among the included studies prevented us from performing a meta-analysis. Second, more studies comparing the efficacy of PRP in the treatment of AA with diverse comparison groups are required to establish a robust conclusion. Such studies would contribute to a more comprehensive understanding of PRP's effectiveness in AA treatment. Third, to minimize potential bias and enhance the reliability of the final outcomes, it is crucial to conduct studies with larger sample sizes. Enlarging the participant pool would strengthen the statistical power and generalizability of the findings. Finally, there is a need for research specifically focusing on exploring the potential benefits of PRP in severe cases of AA. By investigating the effects of PRP in individuals with severe AA, valuable insights can be gained regarding its suitability as a treatment option for those with more advanced forms of the condition. Addressing these limitations will help to enhance the overall understanding and applicability of PRP as a therapeutic intervention for AA.

Overall, PRP is suggested as safer, more effective, and steroid-sparing compared to placebo and minoxidil in terms of hair regrowth and decreased dystrophic hair between patients. Moreover, the patients treated with PRP had fewer side effects, including burning sensation, pain during injection, erythema, edema, ecchymosis, crust formation, and headache. However, the majority of the mentioned side effects were self-limited with no further complications.

5. Conclusion

To conclude, in this systematic review, we found PRP to be a safe and promising therapeutic modality in AA management. Recently, PRP has become a prevalent method in alopecia treatment, but the use of nonsteroid-based procedural therapies for the treatment of AA has remained a controversial method. In conclusion, PRP had significantly better results in treating the patients with AA compared with placebo and minoxidil. However, PRP did not reach statistical significance in terms of its better performance over FCL, MND, triamcinolone, or other steroids, which indicates that PRP can be an alternative therapeutic option to other methods for treating AA. PRP can be considered as a safe, effective, and steroid-sparing treatment method with low complication rates in the treatment of AA compared to other methods of AA treatment with currently proven efficacy.

Abbreviations

AA: Alopecia areata
α-MSH: Alpha-melanocyte-stimulating hormone
TGF-β: Transforming growth factor-beta
MHC: Major histocompatibility complex
PRP: Platelet-rich plasma
DPCP: Diphencyprone
SADBE: Dibutylester
JAK: Janus kinase inhibitors
TrA: Triamcinolone acetonide
AASIS: Alopecia areata symptom impact scale
SALT: Severity of alopecia tool
FCL: Fractional carbon dioxide laser
MND: Microneedling
PDGF: Platelet-derived growth factor
VEGF: Vascular endothelial growth factor
IGF: Insulin-like growth factor.

Data Availability

The data used to support the findings of this study are included within the article.

Additional Points

Capsule Summary. Alopecia areata, which is a common alopecia, is characterized by patchy areas of hair loss. There have been multiple therapeutic options for the management of alopecia areata, such as corticosteroids, immunotherapy, local therapy, or systematic therapies. Platelet-rich plasma, which is an autologous preparation of platelets, promotes hair growth by accelerating the circulation to hair follicles. The present systematic review evaluated the efficacy and safety of using platelet-rich plasma as a treatment option for alopecia areata, which showed that platelet-rich plasma, alongside the conventional therapy with triamcinolone acetonide, is effective in the treatment of alopecia areata.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Authors' Contributions

Razman Arabzadeh Bahri and Zahra Razavi conceptualized the study. Razman Arabzadeh Bahri and Saba Maleki curated the data, investigated the study, and wrote the original draft. Zahra Razavi proposed the methodology. Zahra Razavi, Narges Ghandi, Robabeh Abedini, Amir Houshang Ehsani, and Ala Ehsani supervised the study. Razman Arabzadeh Bahri visualized the study. Razman Arabzadeh Bahri, Saba Maleki, and Zahra Razavi reviewed and edited the manuscript. Razman Arabzadeh Bahri and Arman Shafiee critically revised this study.

Acknowledgments

We thank all the authors of the included studies and all those who contributed to the present study.

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